WHAT IS CLAIMED IS:

1. A frequency converter comprising:

a transconductance unit that outputs a first output signal based on an input signal having a first frequency;

an impedance matching unit that includes at least one inductor through which the first output signal passes; and

a current switching unit that converts the first output signal output from the impedance matching unit to a second output signal having a second frequency based on a local oscillator signal.

2. The frequency converter according to claim 1, wherein the inductor is formed as a part of a monolithic integrated circuit.

3. The frequency converter according to claim 1, wherein the impedance matching unit includes at least one inductor and capacitor.

4. The frequency converter according to claim 1, wherein the transconductance unit includes a first transistor, wherein the input signal is input to a base of the first transistor, and the first output signal is output from a collector of the first transistor, and

the current switching unit includes second and third transistors, wherein the first output signal output from the impedance matching unit is input to emitters of the second and third transistors, and the local oscillator signal is applied between bases of the second and third transistors.

5. The frequency converter according to claim 4, wherein the impedance matching unit comprises:

a first capacitor having two terminals, one terminal being connected to the emitters of the second and third transistors and another terminal being connected to the earth;

a second capacitor having two terminals, one terminal being connected to the collector of the first transistor and another terminal being connected to the earth; and

an inductor having two terminals, one terminal being connected to the emitters of the second and third transistors and another terminal being connected to the collector of the first transistor.

6. The frequency converter according to claim 3, wherein the inductor and the capacitor are formed as a part of a monolithic integrated circuit.

7. The frequency converter according to claim 3, wherein the impedance matching unit is a parallel resonant circuit that includes the inductor and the capacitor, wherein the inductor and the capacitor are formed as a part of a monolithic integrated circuit.

8. The frequency converter according to claim 7, wherein the parallel resonant circuit has a resonance frequency that is two times or more of a frequency of the local oscillator signal.

9. The frequency converter according to claim 7, wherein the parallel resonant circuit has a resonance frequency that is represented approximately by $3\omega_1 \pm \omega_2$ where ω_1 is a frequency of the local oscillator signal and ω_2 is the second frequency.

10. The frequency converter according to claim 7, wherein the parallel resonant circuit has a resonance frequency that is represented approximately by $2\omega_1 \pm \omega_2$ where ω_1 is a frequency of the local oscillator signal and ω_2 is the second frequency.

11. A frequency converter comprising:

a first transconductance unit that outputs a first output signal based on a first input signal having a first frequency;

a first impedance matching unit that includes at least one first inductor through which the first output signal passes;

a first current switching unit that converts the first output signal output from the first impedance matching unit to a second output signal having a second frequency based on a local oscillator signal;

a second transconductance unit that outputs a third output signal based on a second input signal having a phase that is opposite to a phase of the first input signal;

a second impedance matching unit that includes at least one second inductor through which the third output signal passes; and

a second current switching unit that converts the third output

signal output from the second impedance matching unit to the second output signal based on the local oscillator signal.

12. The frequency converter according to claim 11, further comprising a current source that is commonly connected to the first and second transconductance units.

13. The frequency converter according to claim 11, wherein the first and second inductors are formed as a part of a monolithic integrated circuit.

14. The frequency converter according to claim 11, wherein each of the first and second impedance matching units includes further at least one capacitor.

15. The frequency converter according to claim 11, wherein the first transconductance unit includes a first transistor, wherein the first input signal is input to a base of the first transistor, and the first output signal is output from a collector of the first transistor,

the first current switching unit includes second and third transistors, wherein the first output signal output from the first impedance matching unit is input to emitters of the second and third transistors, and the local oscillator signal is applied between bases of the second and third transistors,

the second transconductance unit includes a fourth transistor,

wherein the second input signal is input to a base of the fourth transistor, and the third output signal is output from a collector of the fourth transistor, and

the second current switching unit includes fifth and sixth transistors, wherein the third output signal output from the second impedance matching unit is input to emitters of the fifth and sixth transistors.

16. The frequency converter according to claim 15, wherein the first impedance matching unit comprises

a first capacitor having two terminals, one terminal being connected to the emitters of the second and third transistors and another terminal connected to the earth;

a second capacitor having two terminals, one terminal being connected to the collector of the first transistor and another terminal being connected to the earth; and

a first inductor having two terminals, one terminal being connected to the emitters of the second and third transistors and another terminal being connected to the collector of the first transistor,

the second impedance matching unit comprises

a third capacitor having two terminals, one terminal being connected to the emitters of the fifth and sixth transistors and another terminal connected to the earth;

a fourth capacitor having two terminals, one terminal being connected to the collector of the fourth transistor and another

terminal being connected to the earth; and

a second inductor having two terminals, one terminal being connected to the emitters of the fifth and sixth transistors and another terminal being connected to the collector of the fourth transistor.

17. The frequency converter according to claim 14, the inductors and the capacitors are formed as a part of a monolithic integrated circuit.

18. The frequency converter according to claim 14, wherein each of the first and second impedance matching units is a parallel resonant circuit that includes the inductor and the capacitor, wherein the inductor and the capacitor are formed as a part of a monolithic integrated circuit.

19. The frequency converter according to claim 18, wherein the parallel resonant circuit has a resonance frequency that is two times or more of a frequency of the local oscillator signal.

20. The frequency converter according to claim 18, wherein the parallel resonant circuit has a resonance frequency that is represented approximately by $3\omega_1 \pm \omega_2$ where ω_1 is a frequency of the local oscillator signal and ω_2 is the second frequency.

21. The frequency converter according to claim 18, wherein the

parallel resonant circuit has a resonance frequency that is represented approximately by $2\omega_1 \pm \omega_2$ where ω_1 is a frequency of the local oscillator signal and ω_2 is the second frequency.

22. A radio communication apparatus comprising:

a first frequency converter including

a first transconductance unit that outputs a first output signal based on a first input signal having a first frequency;

a first impedance matching unit that includes at least one first inductor through which the first output signal passes;

a first current switching unit that converts the first output signal output from the first impedance matching unit to a second output signal having a second frequency based on a local oscillator signal;

a second frequency converter including

a second transconductance unit that outputs a third output signal based on a second input signal having the second frequency;

a second impedance matching unit that includes at least one second inductor through which the third output signal passes; and

a second current switching unit that converts the third output signal output from the second impedance matching unit to the fourth output signal having the first frequency based on the local oscillator signal;

a signal generating unit that generates the first input signal, and outputs the first input signal to the first transconductance unit of the first

frequency converter;

a receiving unit that receives the third output signal output from the second current switching unit of the second frequency converter; and

an antenna that receives a signal corresponding to the second input signal, outputs the second input signal to the second transconductance unit of the second frequency converter, and transmits the second output signal output from the first current switching unit of the first frequency converter.

23. A frequency converter comprising:

a first frequency converter including

a first transconductance unit that outputs a first output signal based on a first input signal having a first frequency;

a first impedance matching unit that includes at least one first inductor through which the first output signal passes;

a first current switching unit that converts the first output signal output from the first impedance matching unit to a second output signal having a second frequency based on a local oscillator signal;

a second transconductance unit that outputs a third output signal based on a second input signal having a phase that is opposite to a phase of the first input signal;

a second impedance matching unit that includes at least one second inductor through which the third output signal passes; and

a second current switching unit that converts the third

output signal output from the second impedance matching unit to the second output signal based on the local oscillator signal,

a second frequency converter including

a third transconductance unit that outputs a fourth output signal based on a third input signal having the second frequency;

a third impedance matching unit that includes at least one third inductor through which the fourth output signal passes;

a third current switching unit that converts the fourth output signal output from the third impedance matching unit to a fifth output signal having the first frequency based on the local oscillator signal;

a fourth transconductance unit that outputs a fifth output signal based on a fourth input signal having a phase that is opposite to a phase of the third input signal;

a fourth impedance matching unit that includes at least one fourth inductor through which the fifth output signal passes; and

a fourth current switching unit that converts the fifth output signal output from the fourth impedance matching unit to the fourth output signal based on the local oscillator signal;

a signal generating unit that generates the first and second input signals, outputs the first input signal to the first transconductance unit of the first frequency converter, and outputs the second input signal to the second transconductance unit of the second frequency converter;

a receiving unit that receives a signal output from any one of the third and fourth current switching units of the second frequency

converter; and

an antenna that receives a signal corresponding to any one of the third and fourth input signals, outputs the signal received to any one of the third and fourth transconductance units of the second frequency converter, and transmits a signal output from any one of the first and second current switching units of the first frequency converter.